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VECTOR GENERAL



SOFTWARE ABSTRACTS

introduction

World's leading producer of interactive graphic Vector General, Inc. has invested considerable effort to provide its customers with an extensive set of software packages designed to simplify and enhance the use of its interactive graphic products. A primary emphasis of the company's software has been to configure and develop a set of software building blocks that allow users to create customized application programs in FORTRAN.

All the software described in this document operates on the VECTORGRAPHICS 11 system. In addition some packages have already been adapted for compatibility with the broad range of commercially available minicomputers which are frequently used in conjunction with Vector General's SERIES 3 interactive graphic terminals.

The company maintains a responsive posture to all reasonable requests for special software design or conversion.

Vector General's software library is extensive and continually growing. An expanding USER's Group provides an additional forum for information and software exchange. Its membership includes most of the recognized leaders in the graphics field.

Program Generation Tools

This library of programs represents working tools that enable the user to compile, assemble and edit his source programs. It includes:

The **FORTRAN IV** compiler converts FORTRAN source code into assembly language programs. FORTRAN source programs may be input from such standard devices as magnetic tape, cassettes, disk, punched cards, paper tape, and alphanumeric terminals.

The compiler is optimized to take advantage of the advanced processor options: thus if extended arithmetic or floating point hardware is available, code will be generated to utilize the added instructions provided by the option.

During compilation, the FORTRAN IV compiler provides a comprehensive listing which helps the user debug and document his FORTRAN program. Included in the listing are:

- The source program listing
- The compiled program listing in an object code (machine language) format (optional)
- A list of internal and external program symbols (optional)
- A list of program errors

The user may specify that modules on disk may be loaded (or overlayed) on program segments previously stored in core memory. This ability to overlay makes it possible to execute programs in sections, so that a total program can be physically larger than the available memory. Programs can be overlayed using the efficient "load-on-call" technique that is provided.

The FORTRAN compiler meets the ANSI standards set forth in 1966, so that user programs written on other systems can operate with minimum modifications.

BASIC/PTS is a fast, core-only, single-user BASIC designed for use in interactive environments. BASIC is implemented as an incremental compiler; execution speed is exceptional while the interactive nature of BASIC is retained.

An optional string capability is included. Core conscious users can delete the string support in BASIC and reclaim the space for their programs. Users who desire have Dartmouth-compatible string support complete with string arrays and functions.

A "call" statement is implemented which allows easy interface of assembly language functions; the user function can be called by name and several arguments can be passed.

Interrupt driven support for line printer and high-speed paper tape, as well as support for several floating point options, is available.

An extension to this language called **BASIC-D** is also offered. BASIC-D provides the user access to the graphic capability of the Vector General hardware.

MACRO is a powerful assembler which accepts numeric representations of instructions and converts the code in binary (object) form. It provides full macro capability to simplify frequently used program segments. The user merely specifies the name of the macro and provides the required arguments. The assembler automatically substitutes the arguments in the assembly.

It also provides other useful features. The assembler provides a symbolic program including the location, octal representation, mnemonics and comments. The user can request a partial listing, or a full cross-reference listing. To help in debugging, the assembler provides a list of symbols. This list consists of symbols, arranged alphabetically, and of each line in which the symbol is used. The symbol flags the lines that contain instructions that are destroying a particular symbol.

The generated object code is assigned to physical memory. The assignment is deferred until the code is loaded into memory. The programs are non-relocatable (absolute load) and run on stand-alone computers.

Separately assembled object programs are linked together through global symbols and subroutines to be linked, such as symbolic tags. When the linking program performs such a tag, it searches for the desired routine and performs the linking operation.

VG-MAC is a graphics symbol extension to the library.

- Searches a library of subroutines and links subroutines containing global symbols requested by other object modules
- Outputs the final linked program that can be later loaded by the executive
- Optionally produces a global cross-reference listing
- Creates overlay segments to facilitate the execution of large programs

The linker simplifies program modification by allowing modified subroutines to be separately assembled or compiled. It automatically combines old modules with the newly modified module to produce the completed file.

The librarian program **LIBR** simplifies the linking operation by allowing the user to place debugged object modules in a library for later reference by the linker. In addition to creating a library, it allows the user to list the library directory, and update the library by adding or deleting modules.

An **ABSOLUTE LOADER** is available on paper tape systems to load absolute binary tapes into core.

Test Programs

ATP is a series of standard and troubleshooting test routines which check and verify the performance of the overall system hardware and its optional devices.

GRIT is a basic test package for overall system readiness which exercises all display functions and peripheral device interfaces.

The On-Line Debugging Technique, **ODT**, greatly simplifies program debugging by allowing the user to interactively control the execution of his program.

It causes the program to stop at up to eight user-defined program breakpoints, letting the programmer perform many different operations. For example, he can print out and examine the contents of any location; request the program to search for and print out all words that have a certain bit pattern or all instructions that modify a given word; or specify the number of times that a given program loop is to be executed. When he is ready, he can cause the program to continue execution, stopping at or skipping the breakpoints.

When errors are discovered, the debugger allows the user to change data and/or instructions and immediately test the results.

DICO is a routine designed to aid the sophisticated programmer in debugging a program using the Vector General Display. It displays a dynamic octal dump and the contents of the computer registers. DICO may be used to observe, single step, auto step and/or change any part of a program or task. The following basic functions are provided:

- Up to eight bases for reference
- Up to eight break points
- A display of the program's register
- A dump trace back
- An auto dump mode to dynamically observe core changes
- A method to skip around in core as a function of core contents
- Change core
- Display core relative to one of eight base address

Programs

The On-Line Drawing Package which operates on the Vector General Display software enabling drawing on the display using the system's keyboard and 32-key function switch.

The user can enter straight lines and blocks on the display screen. These pictorial elements are stored, labeled and filed as one entity (or as a completed drawing). All previously stored drawings or symbols may then simply be re-inspected, used or revised.

An important concept of this graphic drawing system is the fact that ODP2 and FDP both operate out of a common graphic data base through FMP. This means that the user can define primitive elements, put them together, and maintain them on file by direct interaction on the CRT display with ODP2, or through user-written subroutines.

For paper tape systems, a relocatable assembler **PAL-11S** converts ASCII source tapes into relocatable binary modules. This assembler gives the advantages of preparing a program in small, mobile segments, as well as conditional assembly capabilities.

The **EDIT-11** text editor allows the user to create new source (symbolic) programs and change or correct existing source programs. Through simple commands from the teletype, a user can:

- Type a program into a buffer
- Read an existing source program into a buffer
- Locate text within a buffer by string comparison or line
- Change, delete, or append sections of text
- Store a new or modified buffer by outputting to a storage device
- Store long command strings in a "macro" area for repeated use
- Merge two files from two different sources

The editor is not limited to the development or modification of user programs. It can be used for the creation and/or manipulation of any text material.

EDIT-D is similar to the above described editor program except that it uses Vector General hardware. It is a graphics source text editor for source applications. It allows use of graphics and display to examine, modify, and character strings.

ED-11, is also available for the creation of ASCII source paper primarily used in a paper tape image is not required.

ing package which provides control from a user's FOR- supports both 2D and 3D conventional color monitor systems.

AN programmer to write, modify picture descriptions, the display screen to an on-line provided for implementing the on-line user.

maintained in buffers (FOR- arrays) defined in the user's add items to these arrays. The structural and control elements generated in the array.

ed picture is complete, it can be ed, treated as a basic element or new picture, or filed. Thus, common s such as a circuit symbol or struc- of an aircraft can be defined once, basic element, and later recalled for use

ne a graphic File Management Package that the storage and retrieval of FDP-formatted ob- and drawings from disk memory. Dynamic mem- buffering techniques are available.

Operating Systems

RSX-11D is a high performance disk based, real-time operating system now available for Vector General users.

The system has been designed to handle real-time tasks in a multiprogramming environment concurrently with on-line program development and batch processing.

The memory management hardware of the computer is used by the operating system to provide a high degree of system integrity, efficient memory management and fast loading and relocation of programs.

The protection scheme features individual task protection for foreground as well as background operations, selective access to reentrant libraries and sharable system commons.

Up to 250 levels of software priorities are available and memory space is allocated dynamically by the operating system to competing disk resident tasks. Critical tasks may be fixed in memory to insure rapid response. Non-critical and/or low-priority tasks can be swapped automatically to make space available for more critical ones.

Real-time tasks can be started from a master console terminal or under program control:

- Immediately
- Later
- At a fixed time-of-day
- Periodically
- After external interrupts
- In synchronization with a time unit

Task priorities and status (disk or memory residency) are dynamically alterable as changing situations or mode of operations demand.

The I/O structure has been designed to provide maximum system throughput and file protection. Systematic queuing of I/O requests, device independence via logical/physical device association, spooling for slow speed devices, on-line assignment of peripherals are all standard features.

The file management package allows for shared files among users, multi-level directories and on-line expansion of file space.

Data files are referenced by names and can be accessed sequentially or randomly. The protection scheme features four classes of users:

- File owner
- Owner's group
- System
- The rest of the world

and four access keys: read/write/modify, read/write, read only, no access.

Read and write lock-keys may also be used to prevent damage to simultaneously opened shared files.

Batch background operations include on-line compilations (FORTRAN IV compiler with ISA real time extensions), assemblies, linking, overlay building, source editing, on-line debugging and on-line task installation.

The **DOS-11** Disk Operating System is a keyboard oriented, program development system. The monitor supports the user throughout the development and execution of his program by providing access to system programs and utilities such as the assembler, linker, editor and debugging package. On systems with at least 16K words of memory, assembler and an ANSI standard FORTRAN IV are also available. The monitor also provides input/output transfers at different levels, ranging from the direct access of device handlers to formatting capabilities, while providing device independence. The user's program can generally be written without concern for specific input/output devices, selecting the most effective or convenient device available for the function to be performed. Input/output transfers are interrupt driven and concurrent. The user selects either TRAN level (device handler level), READ/WRITE level (formatted level) or RECORD/BLOCK level (file-structured, random-access level). The file system on secondary storage utilizes two user specified file structures, linked and contiguous. Linked files can grow serially with no logical limit on their size. Contiguous files must have their lengths declared before use, but can be randomly-accessed by RECORD/BLOCK level input/output requests. Files can be specified and referenced by name by a specific user, and also protected by that user against unauthorized use.

The user communicates with the monitor through keyboard instructions called commands and programmed instructions called requests. The keyboard commands enable the user to load and run programs, assign input/output devices or files, modify and dump memory contents, and retrieve system information. Users

can utilize the assembler to use the programmed requests. The requests may be assembled into the user's program through which the user specifies the operation to be performed by the monitor. The monitor is divided into logical modules and some monitor routines can be swapped into memory as needed, or made permanently resident before or during the run time of a particular program.

BATCH-11 is an expansion of the Disk Operating System which includes batch processing.

A device-independent I/O executive, **IOX**, is offered to paper tape system users which allows convenient interfacing of his software to the supported devices.

Utility Programs

The **PIP-11** Peripheral Interchange to perform file handling including tr listings and file renaming for file de ASCII or binary transfer for all de be used to allocate contiguous fi tion codes, initialize a device dire or transfer a group of files from one

DDL is a display driver and list pro all low level display interfacing in and control, and refresh of the provides hierarchical capability fo play lists.

PEN is a light pen program that plays a tracking cross and allows used as an input device.

TX-3D is a program that provides implementing rotation about any axes. It also provides for nesting scale, translation and rotation.

means for
all three
levels of

The **LINK-11** program combines and r grams assembled by the assembler, link main program with separately assembled

The program:

- Relocates each object module and assigns absolute address
- Links the modules by correlating global symbols
- Prints a load map which displays the assigned absolute addresses (at user option)

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